Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 84

NEW LISKEARD AREA

(NTS 31M/NW)

District of Timiskaming

Compliments of
ONTARIO
MINISTRY OF NORTHERN DEVELOPMENT
AND MINES
Not for resale

by
M.A. Roed

1979

Ontario

Ministry of Natural Resources

Hon. James A.C. Auld
Minister

Dr. J.K. Reynolds
Deputy Minister

Ministry of Northern Affairs

Hon. Leo Bernier
Minister

Art Herridge
Deputy Minister

© OMNR-OGS 1979
Printed in Canada

THIS PROJECT WAS FUNDED BY
THE ONTARIO MINISTRY OF NORTHERN AFFAIRS
AND IS MANAGED BY
THE ONTARIO MINISTRY OF NATURAL RESOURCES

Every possible effort is made to ensure the accuracy of the information contained in this report, but the Ministry of Natural Resources does not assume any liability for errors that may occur. Source references are included in the report and users may wish to verify critical information.

Publications of the Ontario Ministry of Natural Resources and price list are available through the *Map Unit, Public Service Centre, Room 6404, Whitney Block, Queen's Park, Toronto,* and the *Ontario Government Bookstore, 880 Bay Street, Toronto.*

Orders for publications should be accompanied by cheque or money order payable to the *Treasurer of Ontario.*

ISSN 0709-4671
ISBN 0-7743-4360-5

Parts of this publication may be quoted if credit is given. It is recommended that reference to this report be made in the following form:

Roed, M. A.
1979: New Liskeard Area (NTS 31M/NW), District of Timiskaming; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 84, 28p. Accompanied by Maps 5021 and 5025, scale 1:100 000.

1200-79-H of C

CONTENTS

		Page
1.0	Introduction	1
	1.1 Terrain Mapping Program	2
	1.2 Previous Work	2
2.0	Geologic Setting	3
	2.1 Bedrock Geology	3
	2.2 Quaternary Geology	4
	2.3 Physiography	5
3.0	Engineering Terrain Units	6
	3.1 Bedrock	7
	3.2 Moraine	12
	3.3 Glaciofluvial	14
	3.3.1 Eskers and Kames	15
	3.3.2 Outwash Plain	16
	3.4 Glaciolacustrine	16
	3.5 Eolian	19
	3.6 Colluvial	20
	3.7 Organic Terrain	21
4.0	Example of Derived Map: Sand and Gravel Resources	22
	4.1 Selection Criteria and Rating System	22
	4.2 Extractive Priority of Terrain Units	23
5.0	References	25

TABLE

1 – Summary of terrain unit characteristics and engineering significance 10

FIGURES

1 – Diagrammatic sketches showing typical terrain types and their representative letter symbols 8

2 – Generalized isopachs of surficial deposits from water well data. . . . 17

MAPS
(accompanying report)

Map 5021 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, New Liskeard (NTS 31M/NW). Scale 1:100 000.

Map 5025 (coloured) – Northern Ontario Engineering Geology Terrain Study, Sand and Gravel Resources Map, New Liskeard (NTS 31M/NW). Scale 1:100 000.

Northern Ontario

Engineering Geology Terrain Study 84

NEW LISKEARD AREA

(NTS 31M/NW)

District of Timiskaming

by

M. A. Roed[1]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the New Liskeard area, District of Timiskaming. It forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The area, which covers NTS block 31M/NW, lies between Latitudes 47°30′N and 48°00′N and Longitudes 79°31′W and 80°00′W. The economy of the area is based on agriculture, forestry, mining, and tourism. Both agriculture and mining have been carried out in the New Liskeard lowland since the beginning of the century. The Little Clay Belt, which underlies almost the entire map-area, is well known for the fertility of its soil.

---

[1]Consulting Geologist, Geo-analysis Limited, Ottawa, Ontario.

Manuscript approved for publication by the Chief, Engineering and Terrain Geology Section, August 28, 1979. This report is published with the permission of E. G. Pye, Director, Ontario Geological Survey.

Farr Formation is prominent with respect to the terrain units in this report. The remaining Paleozoic rocks are either recessive weathering or do not outcrop and hence have no effect on the terrain.

Faults and joints in the bedrock are numerous and the presence of many faults is reflected in the terrain. The most prominent in the map-area are parallel, northwest-trending fault systems that include the Cross Lake Fault and Timiskaming Fault (Pyke *et al.* 1973).

Mineral potential is high for silver-cobalt in the vicinity of Sutton Bay on Lake Timiskaming, while a belt of high potential for gold and base metals, corresponding to the Archean metavolcanics, cuts across the northwestern part of the area. Mineral potential elsewhere is medium to low (Springer 1977).

2.2 QUATERNARY GEOLOGY:

Quaternary deposits of glacial and nonglacial origin occur throughout the area. Glacial deposits consist of sandy bouldery till in ground moraine and hummocky moraine; glaciofluvial sand and gravel in eskers, kames, outwash plains, and deltas; and glaciolacustrine clay. Nonglacial deposits include eolian sand, alluvial sand and silt, colluvium, and organic deposits of peat.

Northern Ontario was glaciated by continental ice sheets at least four times during the Pleistocene. However, only the deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the New Liskeard area.

The Keewatin lobe of the Laurentide ice sheet advanced southward into the area approximately 100 000 years ago at the beginning of the Wisconsinan (Prest 1970). It ground its way across the rugged Precambrian terrain and over the Paleozoic outlier, deepening pre-existing valleys and disrupting normal drainage. After having advanced as far south as Minnesota, the glacial front has receded to the New Liskeard area by Late Wisconsinan time (approximately 11 000 years ago). It may have disappeared completely from the area and then readvanced to the position presently marked by the Sultan Scarp (Roed 1979) to the west, or it may have formed the Sultan Scarp during a halt in its recession. In either

event, the Sultan Scarp in the Gogama area and some esker and deltaic complexes in this map-area represent a major stillstand of this ice sheet.

Glacial Lake Barlow began to form approximately 10 300 years ago (Prest 1970) in the New Liskeard lowland because drainage along the valley now occupied by Lake Timiskaming was blocked. Deglaciation of the land to the north of the map-area proceeded by mass disintegration of the ice and the entire region is believed to have become ice-free by approximately 10 000 years ago.

By approximately 9 500 years ago, the glacier had receded well to the north of the map-area. Lake Barlow joined with Lake Ojibway at this time to form Lake Barlow-Ojibway. Meltwater from the Elk Lake valley to the west emptied into this lake along the western part of the New Liskeard lowland. Then, approximately 8 700 years ago, the obstructions along the Lake Timiskaming valley were breached and the New Liskeard lowland drained in several stages, one of which may have involved catastrophic erosion, to form the low linear terraces that have been mapped. The higher terraces in the clay of the New Liskeard plains were extensively gullied before complete drainage of all glacial lake waters.

Modern Lake Timiskaming came into existence shortly after these events, and the Ottawa River system and other drainage courses became established. Extensive wind erosion of glaciofluvial sand and gravel deposits occurred throughout the map-area, resulting in dune fields such as the one near Margaret Lake. At present, these dunes appear to be stabilized.

Some post-glacial uplift in the area has resulted in the incised valleys of the Englehart, Blanche, and Wabi Rivers. Landslides have affected these valleys, but otherwise the land has been little modified since the disappearance of the ice sheet.

2.3 PHYSIOGRAPHY:

The New Liskeard map-area is situated in a physiographic division of the Canadian Shield known as the Cobalt Plain (Bostock 1970). The dominant physiographic feature is the New Liskeard lowland, which is a major fault-controlled plain trending northwest. It is flanked by rocky

uplands in the vicinity of Wendigo Lake to the northeast and similar but more subdued rocky uplands on the west.

The lowland can be divided into two parts on the basis of topography. The eastern part is nearly flat and underlain by glaciolacustrine clay beds which were deposited in Glacial Lake Barlow-Ojibway and form the Little Clay Belt. Elevations range from 180 to 360 m above sea level. Some parts of the clay plain are extensively gullied, and long, low, linear scarps and indistinct raised beaches are common in the clay of the Blanche River and Wabi River valleys. Extensive organic terrain occurs in flat, poorly drained areas of the plain. The western part of the lowland is also of low relief, but has somewhat higher elevations and is characterized by more rugged topography with numerous bedrock outcrops and extensive sand plains. Elevations range from 240 to 365 m.

Lake Timiskaming, which occupies a fault-controlled valley, is the largest lake in the map-area. It extends for approximately 60 km south of New Liskeard and is part of the Ottawa River system. Many parts of the lake are in the order of 100 m deep (Hume 1925) and, in some locations, the water may be as deep as 200 m (John Morton, personal communication, 1978).

3.0 ENGINEERING TERRAIN UNITS:

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the significance of each, are discussed in detail. These include bedrock terrain (RL, RN, RP), moraine (MG, MH), glaciofluvial outwash (GO), eskers (GE) and deltas (GD), a large glaciolacustrine plain (LP), and organic deposits (OT). Less significant terrain units include eolian sands (ED) and colluvial deposits (CW). Diagrammatic sketches of typical terrain settings are given in Figure 1. Table 1 summarizes the characteristics and engineering significance of all major terrain units.

3.1 BEDROCK:

Examples:

$$\frac{RL(cLP)(tMG)}{Mjw\text{-}D(M)} \qquad \frac{RN(tMG)}{Mj\text{-}D} \qquad \frac{tMG/RP}{Lwp\text{-}D}$$

Most of the bedrock terrain occurs in the northeast and southwest corners of the area and along the northern half of the area's western boundary. Much of the bedrock terrain (RN) is hilly (n), rugged (j), and of moderate relief (M), but around Wendigo Lake in the northeastern part of the area, there is a prominent rock plateau (RP). Bedrock is frequently exposed at the surface, but a discontinuous mantle of ground moraine till (tMG) and/or glaciolacustrine clay (cLP) or forest litter can occur within the unit. The glacial material ranges in thickness from 1 to 3 m, but locally may be in excess of 10 m thick. Bedrock terrain is well drained (D), but does contain depressions that are seasonally very wet. Patches of glaciofluvial deltaic sand and gravel occur within the unit, southwest of the Wabi Lake in the southwest corner of the map-area. Several well-formed roche moutonnees occur northeast of this lake. Prominent monadnocks include Hudson Rock and Fisher's Rock, located 10 km northwest of New Liskeard. Small accumulations of blocky talus occur in places along the base of steep scarps in bedrock terrain.

A belt of nearly flat-lying Paleozoic rocks extends for 40 km north-northwest of New Liskeard and forms a rock plain (RP) of low relief mantled by a wave-washed (w) layer of till and minor glaciolacustrine deposits.

Since rock is an important engineering material, special attention has been given to designation of bedrock terrain, even if there is some doubt as to whether or not the rock occurs close to the surface. Therefore, some landforms designated as bedrock may in fact have a mantle of ground moraine which would offer no special engineering problems.

The principal engineering significance of bedrock terrain is that it is difficult and expensive to excavate. In terms of access routes, numerous bridges or stream crossings may be required in rugged terrain. On the other hand, bedrock terrain provides excellent foundation conditions

1.1 TERRAIN MAPPING PROGRAM:

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100,000. The terrain information is contained on the Data Base Map (OGS Map 5021, accompanying this report). The Sand and Gravel Resources Map (OGS Map 5025, accompanying this report) is a derived map which classifies the terrain units of the New Liskeard area with respect to overall capability or potential for aggregate extraction.

Interpretation of black and white aerial photographs, at a scale of approximately 1:50 000, was the primary method of obtaining this terrain information. The interpretation includes information from relevant published literature. The main roads in the area were traversed during the summer of 1977 to provide spot checks of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the maps is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard and Roed, in preparation), a companion publication to this series of maps and reports.

1.2 PREVIOUS WORK:

The surficial deposits have been mapped or considered on a reconnaissance basis by Boissonneau (1965, 1968), Prest (1969, 1970), Prest *et al.* (1967), Hughes (1965), Hume (1925), the Ontario Land Inventory (1976), Skinner (1969), Dean (1956), and the Canada Land Inventory (1971). The Quaternary geology of this map-area was recently mapped by Morton *et al.* (1979). Regional bedrock geology has been compiled by Pyke *et al.* (1973); preliminary detailed geologic maps are available, for certain parts of the area, from the Ontario Geological Survey. The bedrock and economic geology of the New Liskeard and Englehart areas have been studied in detail by Lovell (1977) and Lovell and Frey (1976). Hume (1925) and Sinclair (1965) deal with the Paleozoic geology and Lovell and Caine (1970) have considered some aspects of the

structural geology. The mineral potential is summarized by Springer (1977). Approximately 50 engineering reports for the map-area, mainly in the New Liskeard lowland, have been filed with the Soil Mechanics Division of the Ontario Ministry of Transportation and Communications. Representative engineering soils properties have been published by Lacasse and Ladd (1977). An historical account of the exploration and development of the region has been compiled by Cassidy (1976).

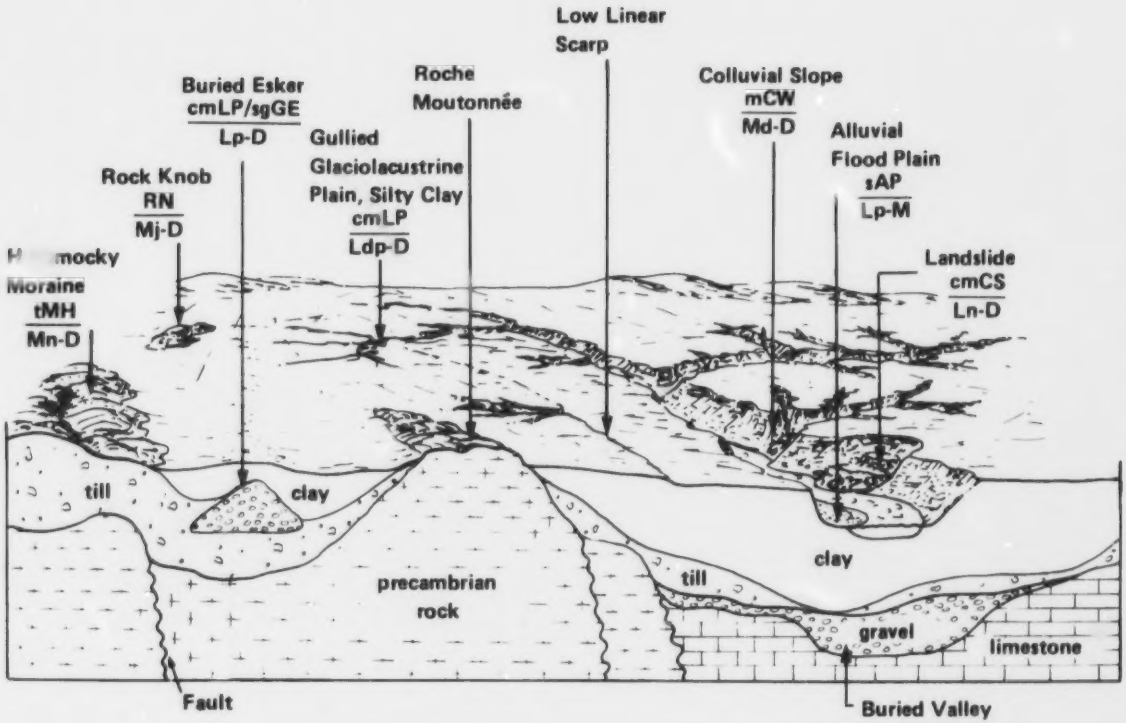
2.0 GEOLOGIC SETTING:

In a general sense, terrain in the map-area is composed of two fundamentally different materials: bedrock of Precambrian or Paleozoic age and unconsolidated surficial material comprising glacial and nonglacial deposits of Quaternary age. These materials, alone or in combination, constitute the basic landform element of the engineering geology terrain units that are to be described in detail. Brief summaries of the bedrock geology, Quaternary geology, and physiography are given below.

2.1 BEDROCK GEOLOGY:

The New Liskeard area is underlain by bedrock of Precambrian age and by an outlier of Paleozoic limestone and shale which extends from the northern end of Lake Timiskaming 40 km north-northwest to Englehart. A belt of Early Precambrian intermediate to mafic metavolcanics cuts through the northwestern part of the area; the northwest corner is occupied by felsic intrusive rocks. The remainder of the Precambrian terrain is composed of sedimentary rocks belonging to the Middle Precambrian Cobalt Group, which are intruded by gabbroic bodies (the Nipissing Diabase), also of Precambrian age (Pyke *et al.* 1973).

The Paleozoic rocks are commonly referred to collectively as the Lake Timiskaming outlier and have received some study (e.g. Hume 1925; Sinclair 1965; Bolton 1970; Lovell and Frey 1976). Four formations of Ordovician age are recognized and referred to as the Liskeard Group (Sinclair 1965). The units are, from oldest to youngest: the Guigues Formation sandstone, the Bucke Formation shale, the Farr Formation limestone, and the Dawson Point Formation shale. The entire sequence appears to be approximately 300 m thick. Only the limestone of the


Low Linear
Scarp
Buried Esker
cmLP/sgGE
Lp-D
Roche
Moutonnée
Colluvial Slope
mCW
Md-D
Alluvial
Flood Plain
sAP
Lp-M
Rock Knob
RN
Mj-D
Gullied
Glaciolacustrine
Plain, Silty Clay
cmLP
Ldp-D
Landslide
cmCS
Ln-D
Moraine
tMH
Mn-D
till
clay
precambrian
rock
till
clay
gravel
limestone
Fault
Buried Valley

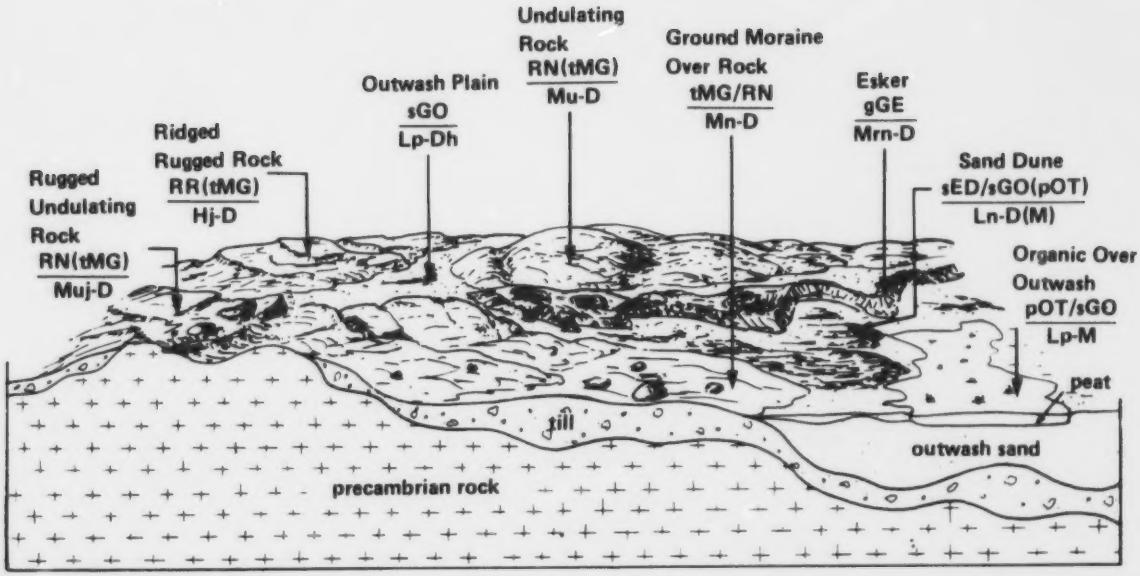


FIGURE 1 – DIAGRAMMATIC SKETCHES SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.

TABLE 1 SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE.

Terrain Unit	Principal Materials	Topography / Drainage	Workability as Construction Material / Permeability	Shearing Strength / Bearing Value	Compaction / Compressibility
Rock Terrain (R)	rock	irregular / dry	not applicable / medium (fracture)	excellent / excellent	not applicable / not applicable
Hummocky Moraine (MH)	till, sand boulders	hummocky / dry	good / medium	good / good	good / low
Ground Moraine (MG)	till, sand boulders	knobby / dry	good / medium	good / good	good / low
Eskers (GE) Kame (GK)	sand gravel	kettled & ridged / dry	excellent / high	excellent / excellent	excellent / low
Outwash (GO) Delta (GD)	sand, gravel	hummocky-planar / dry	excellent / high	excellent / excellent	excellent / low
Glaciolacustrine Plain (LP)	clay, silt fine sand	planar / dry	poor / low	fair / fair	poor / high
Glaciolacustrine Beach (LB)	sand	planar / dry	good / high	good / good	good / low
Alluvium (AP)	sand, silt clay	channelled / mixed	fair / medium	good / poor	fair / medium
Eolian (ED)	sand	ridged, hummocky / dry	fair / high	good / good	good / low
Colluvium Soil (CW,CS)	clay, silt	sloped / mixed	poor / low	poor / poor	poor / high
Colluvium Talus (CT)	rubble	sloped / dry	poor / high	good / poor	poor / low
Organic (OT)	peat	planar / wet	poor / medium	poor / poor	poor / high

Notes:
1. The rating above or below the bar refers to the characteristic or use above or below the bar, respectively, in the column heading.
2. Permeability, compressibility, and frost susceptibility are rated as low, medium, or high; all other characteristics and uses are rated as poor, fair, good, or excellent.

Slope Stability / Frost Susceptibility	Aggregate Supply / Foundations	Highway Subgrade / Route Location	Hydro Easements / Pipeline Routes	Septic Tank Suitability / Solid Waste Landfill	Domestic Groundwater Potential / Large Groundwater Supplies
good (some talus) / not applicable	not applicable / excellent	poor / fair	fair / poor	poor / poor	good / poor
good / low	fair / good	good / good	good / good	excellent / excellent	excellent / good
good / low	fair / good	good / good	fair / fair	excellent / good	good / fair
excellent / low	excellent / excellent	excellent / excellent	good / good	poor / poor	excellent / excellent
excellent / low	excellent / excellent	excellent / excellent	excellent / excellent	poor / poor	excellent / excellent
poor / high	poor / fair	poor / good	good / good	fair / fair	fair / poor
excellent / low	good / good	good / good	good / good	poor / poor	good / poor
fair / medium	poor / poor	poor / poor	poor / poor	poor / poor	good / fair
good / low	poor / good	fair / good	good / good	fair / poor	good / fair
poor / high	poor / poor	poor / poor	poor / poor	poor / poor	fair / poor
good / low	poor / poor	poor / poor	poor / poor	poor / poor	poor / poor
poor / high	poor / poor	poor / poor	poor / poor	poor / poor	poor / poor

3. This is a generalized table intended for use in a number of reports; therefore, all terrain units dealt with in the table will not necessarily appear in each report.

in areas that are unaffected by faults and weak clay zones around joints and faults, and where fracture or joint density is low. The unit possesses potential for aggregate obtained in rock quarry operations; for rip-rap in talus piles at the base of scarps; and for sand and gravel in scattered glaciofluvial deposits and occasionally in the thin sandy bouldery till mantle.

Groundwater potential is generally poor in Precambrian bedrock terrain, but sufficient for scattered domestic demand. However, considerable groundwater production can be expected in fractured localities or along the fault zones. Groundwater is abundant in Paleozoic bedrock and is commonly under artesian pressure (Hume 1925). Bedrock terrain is unsuitable for placement of septic drain tile fields, except where a thick layer (at least 1.5 m) of soil material is present.

Reconnaissance boulder tracing of "float" mineral occurrences is most easily accomplished in bedrock terrain. Stream and lake sediment geochemical sampling in the organic and alluvial units associated with bedrock terrain is capable of outlining anomalies which reflect mineralization in the underlying rock units.

3.2 MORAINE:

Examples:

$$\frac{\text{tMG/RP}}{\text{Lwp-D}} \qquad \frac{\text{tMH(RN)(pOT)}}{\text{Mn-M}}$$

Morainal landforms in this map-area are either ground moraine (MG) or hummocky moraine (MH). Ground moraine consists mainly of sandy bouldery till, usually 3 to 5 m in thickness, and has local relief of 2 to 4 m. Hummocky moraine is also composed of sandy bouldery till, as much as 50 m in thickness, but relief is commonly in the order of 10 to 20 m. The unit is characterized by knobs (n), kettles and kettle lakes (k), and irregular groupings of hills. Gradations from ground moraine to hummocky moraine occur, so that contacts on the maps are approximate.

Ground moraine (MG) is not common in the New Liskeard area. A layer of calcareous wave-washed (w) till (t) blankets the limestone plain of the Paleozoic outlier in the southeastern and central parts of the area. Patches of ground moraine are associated with rock terrain (RN or RL) of low to moderate local relief (L, M) with an undulating (u) or slightly knobby (n) topographic character.

Hummocky moraine (MH) is restricted to the western portion of Lundy Township in the southwest corner of the map-area. It consists of till (t) and includes subordinate amounts of rock (RN) knobs (n) and peaty organic terrain (pOT). Sandy bouldery till, ranging from 5 to 30 m in thickness, is the principal material in this unit, but stratified sand (s) and gravel (g), pockets of silt (m) and sand (s) and local concentrations of large boulders (b) also occur locally. Eskers and kames are commonly associated with hummocky moraine, and depressions in the unit contain organic material (pOT). Topography in hummocky moraine is irregular and knobby or hilly with some kettle lakes. Local relief is commonly in the order of 10 to 20 m. This terrain is well drained (D), but depressions are often wet (w) and occupied by organic material.

Numerous large boulders, patches of poorly drained ground, and the possibility of near-surface bedrock are the principal engineering difficulties that may be encountered in the ground moraine unit. Generally, however, ground moraine poses few serious construction problems and is superior to rock terrain for route construction because grades are lower and the necessity for rock blasting is less probable. Good granular material may be scarce, but the till itself is amenable to beneficiation in some localities. Groundwater potential in the till is generally fair, especially at the contact between bedrock and a till layer of adequate thickness. Also, where the till is greater than 1.5 m in thickness, ground moraine is considered to be one of the best landforms for attenuation of leachate from septic drain tile fields.

Sampling of the basal part of the till for mineral exploration is most easily and efficiently accomplished in ground moraine terrain. Tracing of mineralized float could be most rewarding in ground moraine. Geochemical anomalies in associated organic and alluvial landforms within the ground moraine unit may be of local origin, and follow-up exploration procedures should be easier than in other glacial landforms such as hummocky moraine and glaciolacustrine plains. This unit should therefore receive high priority for drift prospecting and geochemical sampling.

The engineering significance of hummocky moraine is substantial. The texture of the till makes the unit ideal for use in the large earth embankments required for dams and roads. Also, the chance of finding a sizeable source of granular materials within hummocky terrain is good. Although conventional construction techniques can normally be used throughout, the irregular relief of the unit is far from ideal for route location and the possibility of bedrock outcrops exists. Due to the inherent heterogeneous composition of hummocky moraine, sporadic pockets of silt, loose sand, and clay can be expected. Some localities may have an abundance of very large boulders.

Hummocky moraine probably contains the best materials in the map-area for attenuation of leachate from municipal landfills and septic drain tile fields. Groundwater potential in hummocky moraine is excellent, and springs are common at the base of large morainal hills, especially during wet periods of the year.

Although surface drift prospecting techniques can be employed in this terrain unit, it is more difficult to locate a mineral source because (1) the till is so much thicker than in ground moraine, (2) the unit may cover an extensive area, and (3) the material may have been carried a considerable distance from its source. Drilling may be extremely difficult in hummocky moraine due to the presence of boulders and sand and gravel lenses.

3.3 GLACIOFLUVIAL:

Examples:

$$\frac{\text{sgGE}}{\text{Lkn-D}} \qquad \frac{\text{sgGK}}{\text{Ln-D}} \qquad \frac{\text{sgGO}}{\text{Lp-Dh}}$$

Glaciofluvial terrain is common and of highly variable character in the New Liskeard area. The unit includes eskers and kames, outwash plains, and deltas (discussed in Section 3.4).

3.3.1 Eskers and Kames:

The esker (GE) in Beauchamp Township is a prominent feature of the area. It is composed of continuous or discontinuous, sinuous and hummocky ridges of sand and gravel (sg), flanked by small groups of kames and irregular patches of flat or gently rolling outwash plain. Local relief along the esker is in the order of 10 to 15 m; pits, kettle lakes (k), and isolated steep sided knobs (n) are common. This esker complex appears to be composed of up to 20 m of sand and gravel in more or less equal proportions, but minor till inclusions and an upper mantle of till can occur locally. The esker is associated with a glaciofluvial deltaic deposit.

A special type of buried esker occurs beneath the glaciolacustrine clay plain of the New Liskeard lowland. There are many examples, but the one in Chamberlain Township can be traced by a series of low rolling hills consisting of clay which has apparently been draped over the esker. This feature has not been mapped as an esker, but rather as a general glaciofluvial deposit (GO) beneath clay (cLP/sgGO).

Kames are rare in the New Liskeard area. A conspicuous kame, located east of the Blanche River in Casey Township, consists of a low hill composed of sand, gravel, and till.

Although esker and kame units are very well drained, they do include minor patches of poorly drained organic terrain in local depressions. Buried eskers are well drained on the surface, but commonly have a high water table.

Eskers provide one of the best sources of sand and gravel aggregate in the map-area. Potential reserves are extremely large, but to date this source has remained underdeveloped. Continuous esker ridges make excellent routes for access roads, although their sinuous form and some steep topography are disadvantages. Eskers provide one of the best aquifers in the map-area for very large supplies of good quality water. They are not suitable for septic system installation due to the poor attenuation capacity of the sand and gravel for chemicals such as nitrate. Pollution potential in eskers is high.

3.3.2 Outwash Plain:

Outwash plains (GO) are restricted to the southwestern part of the map-area, in the vicinity of Twin Lakes. They consist mainly of gravelly sand (sg) and occur in association with ground moraine, organic terrain, and an esker at Twin Lakes. The landform is well drained (D) where it has been dissected, but much of it is characterized by a high water table (Dh).

The outwash is being quarried for aggregate, but considerably more potential exists. Groundwater potential is high in most glaciofluvial deposits. Glaciofluvial sand and gravel possess minimal attenuation capacity for chemical constituents such as nitrate in leachate from septic drain tile fields. Plans to dispose of sewage and waste in this terrain should be carefully considered due to the potential for pollution.

3.4 GLACIOLACUSTRINE:

Examples:

cmLP / Lp-D	csLP(RN) / Ldn-M	sgLB / Lp-D	sgGD / Lkp-D

Glaciolacustrine sediments (LP) of Glacial Lake Barlow-Ojibway occupy much of the New Liskeard lowland. Silty clay (cm) is the common sediment type in the central part of the basin, while sand (s) and sandy clay (cs) occur near glaciofluvial deposits and the rock terrain adjacent to uplands. Beaches of glaciolacustrine origin are also widespread and deltaic deposits occur in Beauchamp Township.

The clay consists of an upper massive unit and a lower varved unit, which together have been defined as the Barlow-Ojibway Formation (Hughes 1965). The clay is up to 100 m thick, ranges in colour from grey through buff to red, and was deposited in a deeply eroded, preglacial, fault-controlled valley. A map showing the approximate thickness of the surficial deposits (including the clay) is given in Figure 2.

Numerous raised beaches occur in the glaciolacustrine plain of the New Liskeard lowland. The best developed are those located in Beauchamp Township and in Ingram Township. These are up to 15 kilometers long

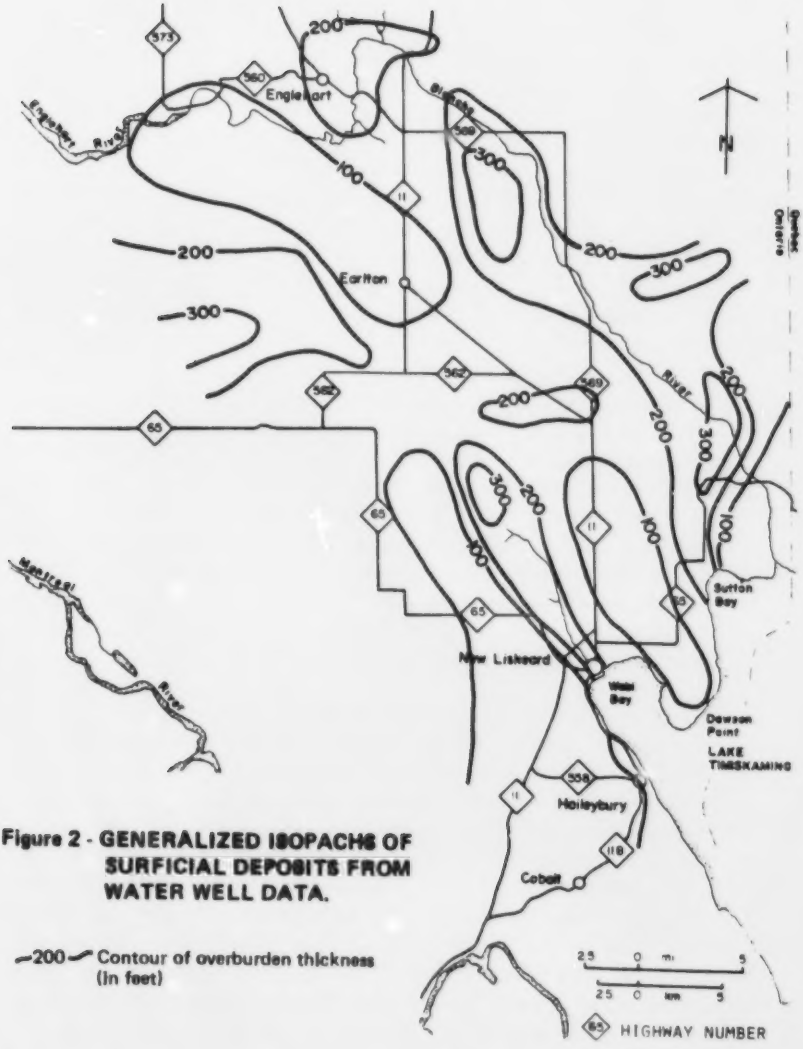


Figure 2 - GENERALIZED ISOPACHS OF SURFICIAL DEPOSITS FROM WATER WELL DATA.

—200— Contour of overburden thickness (in feet)

and one kilometer wide and consist of sandy gravel and gravelly sand. Other minor raised beaches are shown on the surficial geology map of the southern half of the New Liskeard area (Morton *et al.* 1979).

The delta (GD) in Beauchamp and Henwood Townships exhibits large scale deltaic cross-bedding and consists of layers of gravelly sand (sg) and sandy gravel (gs). This unit is well drained and is distinctly pitted (k) in places.

Areas of irregular topography at elevations of less than 300 m in the western part of the New Liskeard lowland have probably been reworked to a certain extent by waters of Glacial Lake Barlow-Ojibway. Isolated pockets of sand and gravel and washed till are common in this terrain. Noteworthy features in the eastern part of the glaciolacustrine plain are the extensive gullies and low scarps, roche moutonnees, and landslides (discussed in Section 3.6).

Although gullies are well developed in the clay, it is believed that much of the erosion which formed the gullies occurred in very short episodes during the drainage of Glacial Lake Barlow-Ojibway. The evidence for this is the existence of gullies on an upper terrace level and none in a downstream direction on a lower level. This relationship can be seen along the low linear scarps north of New Liskeard in Kerns Township and indicates that, as the gullies formed on the upper terrace level, water was still present in the lower part of the basin of Glacial Lake Barlow-Ojibway. The gullies are presently associated with year-round streams and also with streams that are either inactive or ephemeral.

A number of low linear scarps which broadly define terraces are evident in the glaciolacustrine clay unit northwest of the town of New Liskeard. On Ile Mann in Lac Temiscamingue, Quebec, three distinct terrace levels have been observed in the glaciolacustrine unit. The low scarps in the New Liskeard lowland are undoubtedly related to these terrace levels. The unusual linear nature of the scarps could be the result of catastrophic erosion associated with abrupt drainage of Glacial Lake Barlow-Ojibway, or their development may have been controlled by underlying fault scarps in the bedrock. This region was affected by the Timiskaming earthquake of 1935 (Milne *et al.* 1969), so the possibility exists that Quaternary movement along bedrock faults may have led to the formation of the linear scarps.

Aggregate potential in clay terrain is generally poor; however, large gravel deposits probably occur at depth in some locations and the deltaic deposits and beach gravel offer considerable potential. The expense of highway construction in clay terrain is moderate, since aggregate is necessary to improve the road bed but expensive excavations are not necessary.

Groundwater potential in clay terrain is poor, but sufficient water for domestic use can be obtained from gravel and bedrock units which occur beneath the clay. Clay terrain is quite well suited to the installation of septic drain tile fields. The impermeable nature of the clay effectively limits the migration of effluent so that tile fields are usually raised where infiltration is slow. The suitability of clay for solid waste disposal can be considered as fair. Leachate migration is limited due to the impermeability of the clay; however, the occurrence of groundwater ponding in this terrain will increase the possibility of surface water contamination. Further engineering data on clay is given by LaCasse and Ladd (1977). Clay of the glaciolacustrine unit has been developed for brick manufacturing, as discussed by Guillet (1967, 1977).

The deltaic and beach deposits in the glaciolacustrine clay are considered to be excellent foundation materials and good groundwater reservoirs, but poor sites for waste disposal.

3.5 EOLIAN:

Example:

$$\frac{\text{sED/SGO(pOT)}}{\text{Lp-M}}$$

The eolian deposits (ED) consist of silty sand and fine to medium sand (sED) in U-shaped dunes, small hills and ridges, or discontinuous blankets and patches of sand that have no topographic expression.

The only mapped dune field in the New Liskeard area is located around Margaret Lake in southwestern Skead Township and northwestern Bayly Township. Relief ranges from 2 to 5 m, which is also the approximate

thickness of the deposit. The unit is poorly drained and would likely cause engineering problems due to the presence of organic terrain.

Blanket sand is up to 1 m thick and occurs as a mantle over other terrain units, usually adjacent to major dune fields. Because it is difficult to recognize blanket sand in the airphotos, it has not been mapped as a separate unit.

3.6 COLLUVIAL:

Example:

$$\frac{\text{mCW}}{\text{Md-M}}$$

Colluvium consists of soil creep material along slopes, landslide material, and talus deposits along or at the base of slopes. Soil creep material consisting of brown silty clay (cm) has been distinguished as a map unit along the valleys that have been incised into the clay of the New Liskeard lowland. However, all slopes in the map-area are subject to soil creep.

Landslides are common in many places along the Blanche, Englehart and Wabi Rivers, and their tributaries, as well as near some scarps that are developed in clay of the New Liskeard lowland. Only large landslides that are easily recognized in the airphotos have been shown on the map. The action of landslides has been, and still is, an important process in valley formation in the New Liskeard lowland. This is exemplified by the numerous small slides shown in the New Liskeard area by Morton (1977). Two main factors in landslide activity have been noted in this work: (1) bank erosion and undercutting, and (2) poor drainage, either from ponding of surface water or from discharge of groundwater in clay terrain. On the other hand, many clay slopes in some parts of the stream valleys appear to be remarkably stable, despite high slope angles and bank erosion. The wide variation in apparent slope stability is not presently understood.

Small accumulations of rock rubble or talus are common at the base of bedrock scarps. A few deposits have been shown on the map, but generally talus deposits cannot be easily recognized in the airphotos.

Shallow foundations may be damaged on a slope affected by soil creep. This type of colluvial unit should be considered as sensitive or hazardous terrain for planning purposes. The presence of landslides indicates major slope stability problems that could threaten any structure. For the clay slopes of the New Liskeard lowland, detailed studies are required prior to engineering construction and residential development.

The principal engineering significance of the talus unit is that it is a source of rip-rap and granular material. However, the unit is also indicative of rock fall and should be classed as hazardous terrain for planning purposes.

3.7 ORGANIC TERRAIN:

Examples:

$$\frac{\text{pOT/cmLP}}{\text{Lp-M}} \qquad \frac{\text{pOT}}{\text{Lp-M}}$$

Organic terrain (OT), composed primarily of peat (p), occurs throughout the map-area in association with all other terrain units, but extensive peat bogs in flat areas or depressions are particularly conspicuous in the New Liskeard lowland. Most of these deposits are underlain by clay (pOT/cmLP), are poorly drained (M), and occupy linear belts of considerable extent. Lovell and Frey (1976) found up to 4.5 m of peat in the Maybroke peat bog, located in Kerns and Harley Townships.

Drainage of organic terrain in the New Liskeard lowland has resulted in reclamation of land for agriculture. There appears to be considerable potential for further reclamation. Also, the peat itself may have economic potential. Organic terrain provides the worst possible foundation conditions for engineering structures and roads. The unit is very compressible, has low shear strength, and is water-saturated most of the time. It is commonly classified as hazard land for planning purposes. Groundwater quality is very poor in organic terrain, and the unit is unsuitable for the location of septic drain tile fields.

The success of geochemical prospecting in organic terrain depends largely on the setting of the unit. A greater number of geochemical anomalies

would probably be found in organic terrain associated with bedrock and ground moraine units than in organic terrain associated with hummocky moraine or extensive glaciofluvial and glaciolacustrine plains.

4.0 EXAMPLE OF DERIVED MAP: SAND AND GRAVEL RESOURCES

The Data Base Map (OGS Map 5021, accompanying this report) forms a basic framework of resource characteristics that allows development of a wide variety of engineering or planning derivative maps. A derivative map can be defined as a graphic representation of the terrain in terms of its potential with respect to a specific engineering or planning use, or a number of uses. Derivative maps are needed because many people who have special interests in the map-area do not have the geological or engineering expertise to fully interpret the Data Base Map for their particular application. The objective of presenting a derivative map in this report, therefore, is to demonstrate how an easily understood illustration can be produced from the Data Base Map.

The derivative map (OGS Map 5025) included in this report is a Sand and Gravel Resources Map which classifies the terrain units of the New Liskeard area into five rating categories with respect to overall capability or potential for aggregate extraction. Other types of derived maps are discussed in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed, in preparation).

4.1 SELECTION CRITERIA AND RATING SYSTEM:

Criteria incorporated into the rating system are (1) suitability for use as aggregate, (2) size of deposit, (3) ease of extraction with respect to depth, and (4) the drainage condition of the terrain unit. The extractive priority of aggregate deposit types, in decreasing order, is: surface deposits, buried deposit, and three other types in which the potential is limited by one or more major constraints.

Since there has been no test drilling or sampling of the deposits discussed below, suitability for aggregate use has been inferred from information on the Data Base Map, all numerical estimates are preliminary, and the results must only be considered a general indication.

4.2 EXTRACTIVE PRIORITY OF TERRAIN UNITS:

Eskers, kames, and glaciofluvial deltas that occur at the surface are the most suitable units for aggregate extraction. These are classified as Priority 1 on the Sand and Gravel Resources Map (OGS Map 5025, accompanying this report). Their suitability for use as aggregate is high, with an expected 50% yield of gravel-sized particles throughout most of the units. Aggregate suitability is especially high in the central core or ridge within an esker complex. Many eskers continue for great distances, but, are sometimes discontinuous at surface or buried. The most important surface esker complex trends north for a distance of 11 km through northeastern Marter Township and southeastern Catharine Township, near Highway 624 in the northern part of the map-area. Assuming an average depth of 15 m, it is estimated that 50 million m^3 or 88 million tonnes of gravel may be present in this deposit. Aggregate is presently being extracted from this unit near Highway 624.

Very large gravel deposits, in the form of an esker complex and a glaciofluvial delta, occur in Beauchamp Township on the western boundary of the area. Both deposits are estimated to be at least 15 m thick and together cover an area of approximately 17 km^2. There may be as much as 300 million tonnes of gravel in these deposits. They extend into the adjacent Elk Lake map-area where there may be a further 300 million tonnes of gravel.

The advantage of using eskers and deltas as sources of aggregate is the ease of extraction due to hilly topography. Drainage is excellent in most esker and delta terrain and the water table in many cases is below a depth of 15 m. Access is presently available to all major eskers and deltas located in the New Liskeard map-area.

Many gravel deposits in glaciofluvial units have excellent extraction potential, but are buried beneath 5 to 10 m of overburden, usually varved clay, and are generally extensions of, or similar to, Priority 1 deposits. Thus, they are classified as Priority 2 on the Sand and Gravel Resources Map. Suitability for use as aggregate is excellent and potential for extremely large quantities of aggregate exists, but due to the depth to the deposits, they cannot be given top priority.

Terrain units possessing good potential for use as an aggregate supply, but with one major constraint, are classified as Priority 3. For example, many excellent gravel deposits, scattered throughout the map-area, are deeply buried beneath at least 10 m of overburden. The Priority 3 category also includes outwash terrain that is affected by a high seasonal water table, and some hummocky moraine, ground moraine, and other outwash deposits in which the sand to gravel ratio is greater than that for units included in either of the Priority 1 or 2 categories.

Terrain units which fall into the Priority 4 category are those which have more than one major constraint limiting their aggregate extraction potential. For example, glaciolacustrine beaches have an estimated maximum thickness of 6 m, but are generally less than 3 m thick. The sand to gravel ratio is high so that the combination of small quantity and poor suitability limits the potential of the unit. Also included in this category would be a large, deeply buried deposit with a high water table.

The Priority 5 category includes small isolated deposits which are suitable for access road construction, but not as a major aggregate source due to their limited extent. Many of these isolated deposits occur in ground moraine and hummocky moraine, where these units are subordinate landforms in bedrock terrain. They also include minor gravel bars in an alluvial terrain unit. These small deposits often have excellent suitability for use as aggregate, but unsatisfactory quantity and location limit their usefulness.

5.0 REFERENCES:

Baer, A. J., Poole, W. H. and Sanford, B. V.

1978: Riviere Gatineau, Quebec-Ontario, Geological Survey of Canada, Map 1334A, scale 1:1 000 000. Sheet 31 of the Geological Atlas of Canada.

Boissonneau, A. N.

1965: Surficial Geology, Algoma, Sudbury, Timiskaming and Nipissing; Ontario Department of Lands and Forests, Map S465, scale 1:506 880 or 1 inch to 8 miles. Surficial geology 1962, 1963.

1968: Glacial History of Northeastern Ontario II. The Timiskaming-Algoma Area; Canadian Journal of Earth Sciences, Vol.5, No.1, p.97-109.

Bolton, Thomas E.

1970: Echinodermata from the Ordovician (*Pleurocrystites, Cremacrinus*) and Silurian (*Hemi cystites, Protaxocrinus, Macnamaratylus*) of Lake Timiskaming Region, Ontario and Quebec; p.59-66 *in* Contributions to Canadian Paleontology, Geological Survey of Canada, Bulletin 187, 123p.

Bostock, H. S.

1970: Physiographic Subdivisions of Canada; p.9-30 *in* Geology and Economic Minerals of Canada, edited by R. J. W. Douglas, Geological Survey of Canada, Economic Geology Report No.1, 5th edition, 838p.

Canada Land Inventory

1971: Soil Capability for Agriculture; Canada Department of Regional Economic Expansion, Catalogue No. EN64/2-31M, scale 1:250 000.

Cassidy, G. L.

1976: Arrow North-The Story of Timiskaming; Highway Book Shop, Cobalt, 398p.

Dean, W. G.
1956: Glacial Features of the Hearst-Cochrane Map-Sheet Area, An Aerial Photograph Reconnaissance; The Canadian Geographer, No.8, p.35-45.

Gartner, John F., Mollard, J. D., and Roed, M. A.
in preparation: Ontario Engineering Geology Terrain Study Users' Manual; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 1.

Guillet, G. R.
1967: The Clay Products Industry of Ontario; Ontario Department of Mines, Industrial Mineral Report 22, 206p. Accompanied by Maps 2130, 2131, scale 1 inch to 16 miles.
1977: Clay and Shale Deposits of Ontario; Ontario Geological Survey, Mineral Deposits Circular 15, 117p. Accompanied by Map 2358, scale 1:2 000 000.

Hughes, O. L.
1965: Surficial Geology of Part of the Cochrane District, Ontario, Canada; p.535-56 *in* International Studies on the Quaternary (collected papers of 7th INQUA Congress, Boulder, Colorado, 1965), edited by H. E. Wright and David G. Frey, Geological Society of America, Special Paper 84, 565p.

Hume, G. S.
1925: Palaeozoic Outlier of Lake Timiskaming, Ontario and Quebec; Geological Survey of Canada, Memoir 145, 129p.

Lacasse, Suzanne M., Ladd, Charles C., and Barsvary, Alex K.
1977: Undrained Behaviour of Embankments on New Liskeard Varved Clay; Canadian Geotechnical Journal, Vol.14, No.3, p.367-388.

Lovell, H. L.
1977: Geology of the Englehart-Earlton Area, District of Timiskaming; Ontario Geological Survey, Miscellaneous Paper 69, 16p. Accompanied by Map P.1249, scale 1:31 680 or 1 inch to ½ mile.

Lovell, H. L. and Caine, T. W.
1976: Lake Timiskaming Rift Valley; Ontario Department of Mines, Miscellaneous Paper 39, 16p.

Lovell, H. L. and Frey, E. D.
1976: Geology of the New Liskeard Area; Ontario Division of Mines, Geoscience Report 144, 34p. Accompanied by Maps 2300, 2301, scale 1:31 680 or 1 inch to ½ mile.

Milne, W. G., Smith, W. E. T. and Rogers, G. C.
1969: Canadian Seismicity and Microearthquake Research in Canada; Canadian Journal of Earth Sciences, Vol.7, No.2, Pt.2, p.591-601.

Morton, J. C., King, R. C. F., and Kalin, M. W.
1979: Quaternary Geology of the New Liskeard Area, District of Timiskaming; Ontario Geological Survey, Preliminary Map P.2291, Geological Series, scale 1:50 000. Geology 1972, 1977.

Ontario Land Inventory
1976: Land Classification, Haileybury, 31M, Edition 1 ASE, Series A501; Ontario Centre for Remote Sensing, Ministry of Natural Resources.

Prest, V. K.
1969: Retreat of Wisconsin and Recent Ice in North America; Geological Survey of Canada, Map 1257A, scale 1:5 000 000. Compiled 1969.
1970: Quaternary Geology of Canada; p.675-764 *in* Geology and Economic Minerals of Canada, edited by R. J. W. Douglas, Geological Survey of Canada, Economic Geology Report No.1, 5th edition, 838p.

Prest, V. K., Grant, D. R. and Rampton, V. N.
1967: Glacial Map of Canada; Geological Survey of Canada, Map 1253A, scale 1:5 000 000. Compilation 1964-1966.

Pyke, D. R., Ayres, L. D., and Innes, D. G.
1973: Timmins-Kirkland Lake, Cochrane, Sudbury, and Timiskaming Districts; Ontario Geological Survey, Map 2205, Geological Compilation Series, scale 1:253 440 or 1 inch to 4 miles. Geological compilation 1970, 1971.

Roed, M. A.
1979: Elk Lake Area (NTS 41P/NE), District of Timiskaming; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 83, 18p. Accompanied by Map 5020, scale 1:100 000.

Sinclair, G. Winston
1965: Succession of Ordovician Rocks at Lake Timiskaming; Geological Survey of Canada, Paper 65-34, 6p.

Skinner, R. G.
1969: A Summary of the Quaternary Stratigraphy of Northern Ontario, Canada; unpublished manuscript, University of Washington, Seattle, 12p.

Springer, Janet
1977: Ontario Mineral Potential, Gogama Sheet and part of Ville-Marie Sheet, Districts of Sudbury and Timiskaming; Ontario Geological Survey, Preliminary Map P.1514, Mineral Deposits Series, scale 1:250 000. Compilation 1976, 1977.

MAPS
NOT
FILMED

CARTES
OMISES